Section 3:

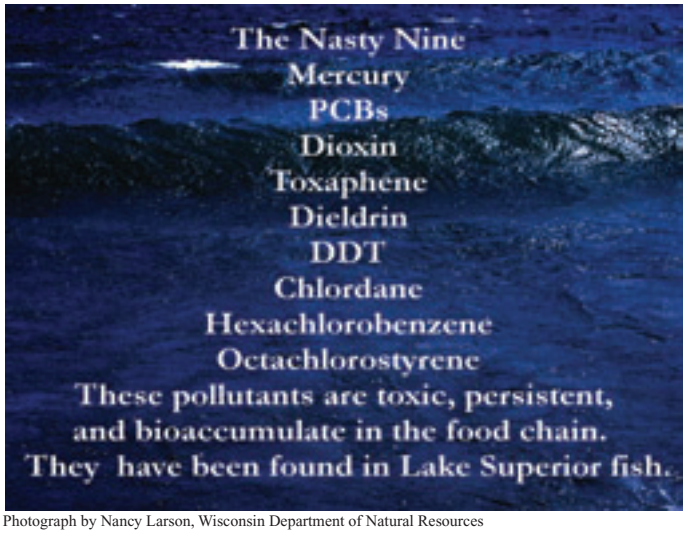
Critical Pollutants

Aguasabon River, Ontario
Photograph by Patrick T. Collins,
Wisconsin Department of Natural Resources

This section addresses the status of critical pollutants in the Lake Superior basin. It is organized in two subsections: 3.1-The Zero Discharge Demonstration Program (ZDDP) and 3.2-Air Transport and Deposition of Pollutants: Local and Long-Range Sources.

3.1 The Zero Discharge Demonstration Program

A key component of the effort to achieve sustainability in the Lake Superior basin is the reduction in toxic loadings to the lake. The goal is to eliminate sources of the nine critical pollutants (The Nasty Nine) in the Lake Superior basin by the year 2020 in a stepwise manner (see the schedule in Table 3-1). The Lake Superior Binational Program's ZDDP is designed to achieve that goal and is unique in the Great Lakes. The key to zero discharge and zero emission is pollution prevention. The ZDDP is an experimental program intended to end the use of the nine critical pollutants in industrial processes and products and to prevent the release of these pollutants in the Lake Superior basin.



Photograph by Nancy Larson, Wisconsin Department of Natural Resources

Why Zero Discharge for Lake Superior?

The idea of a Lake Superior "zero discharge demonstration" received increasing public support during the 1980s and arose from the recognition that Lake Superior provides the best opportunity among the Great Lakes to achieve zero discharge. The Binational Program to Restore and Protect the Lake Superior Basin was announced in 1991 when an agreement was reached among the governments around Lake Superior to work together on the zero discharge demonstration and on broader ecosystem issues. The 1991 agreement stresses voluntary pollution prevention but acknowledges that enhanced controls and regulations may be necessary.

Table 3-1
Lake Superior Load Reduction Schedule
Chemical load reduction schedule for sources in the Lake Superior basin (percent reduction shown against 1990 baseline)

Chemical	2000	2005	2010	2015	2020
Mercury	60	--	80	--	100
PCBs	33	60	95	--	100
Dioxin, HCB, and OCS	--	80	--	90	100
Pesticides	100	--	--	--	--

HCB = Hexachlorobenzene
OCS = Octachlorostyrene

The Lake Superior basin zero discharge goal is challenging. Significant progress has been made over the last ten years by enforcing strong environmental regulations, changing industrial development patterns, encouraging pollution prevention, and altering the habits of individuals; however, a significant amount of work remains to be done.

Pollutant Concentrations in the Environment

Reducing sources contributing toxic pollutants to Lake Superior will eventually result in pollutant reductions in the basin's ecosystem. Within the Lake Superior basin, the ZDDP reduces toxic chemicals at their sources. Reductions in toxicants carried in the atmosphere from distant sources are also important. The relationships between levels of pollutants entering the lake and the levels seen in the water, fish, and wildlife are complex.

Concentrations of toxic organic contaminants in Lake Superior declined more than 50 percent between 1986-87 and 1996-97. Nonetheless, of the nine critical pollutants, concentrations of dieldrin (a pesticide) and PCBs (for example, used in electrical equipment) in Lake Superior continue to exceed the most stringent water quality standards.[1]

Contaminant levels have been monitored in herring gull eggs since 1974. The most recent analysis of data shows that concentrations of five critical pollutants, PCBs, DDE, HCB, dieldrin, and dioxin (TCDD) in herring gull eggs have declined by 51 percent to 97 percent since they were first measured. Current trends show that, with the exception of dioxin, levels continue to decline. TCDD at the Granite Island colony is not exhibiting any trend, though it has declined since 1987. Mercury values have not been tracked as consistently, but they too have declined by approximately 50 percent since 1974.[2]

State and provincial jurisdictions in the Lake Superior basin currently issue sportfish consumption advisories. Concentrations of toxic substances in fish tissue are expected to decline as toxic inputs to the lake decrease. However, the time required for toxic substance levels to fall below health concern thresholds may be on the order of decades, and agencies will likely continue to issue fish advisories for some time to come.

Working Together to Meet the Zero Discharge Goal

Efforts to reduce releases of the nine critical pollutants are increasing as governments, industries, communities, and citizens work to identify creative ways to reduce the use and discharge of these chemicals. Progress has already been made through changes in industrial activities and processes and through community-based programs.

Out-of-Basin Sources and Reductions

The ZDDP focuses on air emissions, water discharges, and use or formation of the nine critical pollutants within the Lake Superior drainage basin. However, sources outside the basin greatly affect the lake. With its large surface area, Lake Superior receives a relatively high deposition of airborne

Children are at more risk than adults from toxic substances.
Photograph by Jamie Dunn, Wisconsin Department of Natural Resources

[1]Open Lake Monitoring Program, Environment Canada, 2000
[2]Canadian Wildlife Service, Environment Canada.

toxics from distant and local sources. Atmospheric deposition is further discussed in Subsection 3.2.

National and International Activities

Actions taken on the national and international levels play an extremely important role in protecting Lake Superior. National programs in the 1990s led to reduction of the mercury content in house paints and small-voltage batteries. In the United States and Canada, agreements are now in place with national dental associations for the virtual elimination of mercury use, and there is a similar U.S. agreement with the American Hospital Association. U.S. regulations for waste incinerators will reduce air emissions nationally and will thus have a beneficial effect on Lake Superior. Additional strategies are needed for Lake Superior critical pollutants because they all have airborne components. Long-range transport of toxic substances is an issue for all the Great Lakes. Efforts under the LaMPs are coordinated with the Great Lakes Binational Toxics Strategy to address pollutant reductions on a broader scale.

Industry Changes Affecting the Lake Superior Basin

Significant progress has been made in reducing releases of the Nasty Nine pollutants from large-source categories. Between 1990 and 2000, mercury use and releases in the Lake Superior basin decreased to the extent that the LaMP's 60 percent target was met. Consumer and commercial products have been significant sources of mercury. Mercury-containing products can include thermometers, switches, dental amalgams, thermostats, button batteries, and fluorescent lamps. Industrial raw materials can also contain unwanted mercury. The elimination of mercury from latex paints and batteries was a significant pollution prevention success of the manufacturing sector in the 1990s.

The 1990s were also a decade of mining facility closures in the basin, which reduced mercury emissions but at a large social and economic cost to the region. Additionally, Lake Superior pulp and paper mills converted to chlorine dioxide bleaching of pulp and thus have dramatically reduced their dioxin discharges to the lake. In addition, PCB use in mills is being phased out in Canada and reduced in the United States.

Sniffing Out the Hidden Mercury

Schools in the Lake Superior basin are getting help from Clancy in finding and eliminating mercury. Clancy is a floppy-eared former dog pound inmate. Clancy can detect mercury vapor at low levels. With assistance from the St. Paul Police Department, he was trained by a Minnesota Pollution Control Agency (MPCA) employee to sit when he detects mercury. Some of Clancy's training was conducted in schools in northeastern Minnesota, where he detected not only the mercury used in the training but also mercury in laboratory sinks and a used mercury spill kit. Now that he has graduated from training, Clancy and his trainer and handler, Carol Hubbard, will be visiting schools that are participating in MPCA's Mercury-Free Zone program. This program was funded by U.S. EPA's GLNPO and is based on a successful program in Sweden. Thus far, Clancy and the two mercury-sniffing dogs in Sweden have not experienced any health problems associated with mercury exposure.

Clancy the mercury-sniffing dog and Carol Hubbard, his handler.
Photograph by Anne Moore,
Minnesota Pollution Control Agency

Community Pollution Prevention and Outreach in the Lake Superior Basin

Many communities around the basin are working on ways to prevent pollutants, particularly mercury, from entering the Lake Superior environment. Lake Superior basin communities are working to teach and motivate their citizens to use alternatives to mercury-containing products. By working with its

What is a Lumex?

A) A Doctor Seuss character?

B) A glow-in-the-dark watch?

C) A portable mercury vapor analyzer?

A Lumex is a portable mercury vapor analyzer. Developed in Russia to detect mercury leaking from mercury ballast in submarines, it is now being put to use in North America. It is faster and a thousand times more sensitive than the standard industrial hygiene instrument for detecting mercury (the Jerome meter), and it is more portable than other sensitive instruments. The Lumex measures only elemental mercury in air; it does not measure other forms of mercury.

MPCA, MDEQ, and WLSSD own Lumex instruments. U.S. EPA's GLNPO funded WLSSD's purchase of the Lumex. They are using the Lumex in a wide variety of applications and are finding mercury hot spots in both commercial and residential settings. Lumex readings in outdoor air are typically less than 5 nanograms per cubic meter (ng/m3). Indoor readings are usually 10 to 20 ng/m3, and the breath of individuals with amalgam fillings produces readings ranging from 100 to 5,000 ng/m3.

Jamie Harvey uses a Lumex unit to test for mercury at an industrial site.
Photograph by D. Hansen,
Minnesota Pollution Control Agency

wastewater-generating customers and by conducting hazardous waste collections, the Western Lake Superior Sanitary District (WLSSD) in Duluth has reduced mercury discharges from its treatment plant. In 1997, WLSSD developed a "Blueprint for Mercury Elimination" guide for wastewater treatment plants. The community-based approach has caught on around the basin. Education and outreach are major parts of all these community efforts. In the U.S. portion of the basin, projects are underway in Duluth and at the Fond du Lac and Grand Portage Reservations in Minnesota; in Marquette and at the Keweenaw Bay Indian Community in Michigan; in Superior, Ashland, and at the Red Cliff Band of Lake Superior Chippewa Reservation in Wisconsin. In addition, EcoSuperior, a Thunder Bay nonprofit community group, is leading a multiyear mercury recycling and outreach project on the Canadian north shore. Examples of cooperative outreach include a project jointly carried out by the City of Superior, Wisconsin, and EcoSuperior in Thunder Bay and a "twinning" project involving schools in the two communities.

Progress on LaMP 2000

LaMP 2000 lists 23 general strategies for pollutant reduction. Various individual actions are listed under each of these strategies along with information on which agencies are committed to initiating or pursuing funding for the actions between 2000 and 2002. Fulfillment of the actions will bring us closer to the 2005 and 2010 milestones.

A complete list of actions for the Lake Superior basin will be contained in a new "Great Lakes Commitment Tracking Database" that will be posted at *http://epa.gov/glnpo/lakes.html*. The following is a summary of the strategies in LaMP 2000 and some accomplishments to date.

Mercury Strategies and Related Actions

Voluntary programs for mercury reduction in the basin range from national programs to those that apply in a particular jurisdiction to very specific voluntary reductions. Examples of voluntary reduction programs include the following:

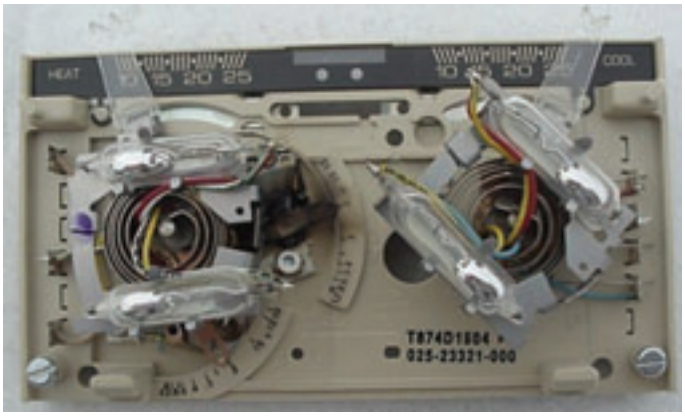
- Training programs for health care and dental professionals to learn about pollution prevention

in Thunder Bay, Duluth, Superior, and Marquette and at the Fond du Lac Reservation

- A statewide, voluntary, mercury emission reduction program in Minnesota that includes seven facilities in or near the Lake Superior basin
- Outreach efforts that led to a Minnesota taconite mineral processing facility removing over 400 kilograms of mercury through process controls and replacement of mercury-bearing equipment

Incentives to reduce mercury use can cover a wide range of efforts:

- Federal, provincial, and state governments fund LaMP pollution reduction activities. Some of the state funding comes from the Great Lakes Protection Fund.



Mercury switches in a thermostat.
Photograph courtesy of EcoSuperior

- Several U.S. programs provide mercury-free laboratory thermometers, barometers, and blood pressure measuring equipment to schools and hospitals.

Mercury release in the utility and mining sectors can be reduced through use of new technology and by changing patterns of energy consumption. Cost-effective pollution control technologies are being explored for coal-fired power plants and may be applicable to some mining operations. While these technologies are being developed, energy conservation continues to be an important option for the basin.

Current actions to reduce mercury from the utility and mining sectors include the following:

EcoSuperior Merc-Divert Superior Program

Thermostat Recycling Project

The nonprofit environmental group EcoSuperior operates a program to recycle standard, wall-mounted thermostats that have been removed during home and industrial heating renovations. Most thermostats contain approximately 3 grams of mercury, but some contain substantially more than this.

The program operates in major communities along the north shore of Lake Superior, including Thunder Bay, Nipigon, Schreiber, Terrace Bay, Marathon, White River, and Wawa. The goal of the program is to divert the mercury that the instruments contain from both the waste stream and the environment.

Recycling depots are located at heating supply outlets and hardware stores. Collected thermostats are sent to Honeywell Inc., and the mercury that they contain is reused rather than landfilled. To date, the program has diverted approximately 1.2 kilograms of mercury from landfills.

Fluorescent Light Recycling

EcoSuperior leads a program to recycle fluorescent lights in Thunder Bay and other north shore communities. Conventional fluorescent lamps are the most commonly used light source in commercial and consumer lighting and close to 600 million fluorescent lamps are disposed of annually in North America. As each bulb contains between 9 and 40 milligrams of mercury, used bulbs contribute significant quantities of this toxic substance to the environment.

Fourteen industries, institutions, and municipalities participate in the program in Thunder Bay, Red Rock, Terrace Bay, and Marathon. The program includes every paper mill on the north shore of Lake Superior. All mercury in the lamps disposed of is recovered and recycled for further use. To date, approximately 1 kilogram of mercury has been diverted from landfills.

EcoSuperior's thermostat and fluorescent light recycling programs are supported by Environment Canada's Great Lakes Sustainability Fund, the Ontario Ministry of the Environment, and the City of Thunder Bay.

- EPA's nationwide Energy Star program, which was recently adopted in Canada
- Mercury emission regulations for utilities, including Wisconsin's 2001 proposed mercury emission regulation
- U.S. EPA's determination in December 2000 that it would regulate mercury emissions from coal-fired power plants (U.S. EPA will propose the associated regulations by the end of 2003 and will publish the final regulations by 2004.)
- Development of Canada-wide mercury standards for the electrical utility sector by the federal and provincial ministers
- Efforts are ongoing by the Bad River, Grand Portage, and Keweenaw Bay Tribes to relamp, conserve energy, and explore use of alternative energy

The strategies for mercury-bearing products organize actions to reduce use of mercury- containing devices and promote use of alternative products. There has been significant recent activity in identifying, collecting, and disposing of mercury-bearing products. Efforts include the following:

- Implementing mercury thermostat take-back programs in Canadian north shore communities and Superior, Wisconsin.
- Signing of agreements between Environment Canada and major pharmacy retailers in Ontario to voluntarily remove mercury thermometers from pharmacy shelves.
- Encouraging the public to return thermometers to participating pharmacies in a pilot program in Thunder Bay.
- Conducting thermometer swaps at schools, at reservations, and in surrounding communities and clinics in the United States.
- Implementing policies in several jurisdictions to limit purchases of mercury-bearing products.
- Instituting various school programs, including a U.S. EPA "Mercury in Schools" outreach effort in 2001 and 2002, mercury-free schools in Michigan by 2004, and a variety of basin-specific mercury education efforts such as Minnesota's "Mercury-Free Zone" and the "Northwest Wisconsin Mercury-Free Schools." School programs are also used as opportunities for education and often incorporate curricula developed to teach school children about sources of mercury and its effect on the environment.
- Conducting incentive and collection programs in Michigan, Minnesota, and Wisconsin to remove mercury manometers from dairy farms; pollution prevention projects in the health care sector, including a project in Michigan's Upper Peninsula; workshops in Superior, Wisconsin; and a workshop for tribes hosted by the Fond du Lac Band.
- Signing of a harmonizing standard by federal and provincial environment ministers under the Canada-wide Standards Process in 2001 to reduce the release of mercury from dental practices by 95 percent by 2005, using 2000 as the base year. Application of best management practices is to include use of ISO-certified amalgam traps.

Although the Lake Superior Binational Program stresses voluntary reductions, it is recognized that regulations are sometimes needed and often have the beneficial effect of leveling the playing field for permittees. Some of the regulatory efforts that have been made by various jurisdictions to reduce mercury use include the following:

- Resolutions in Duluth, Minnesota; Superior, Wisconsin; and Douglas County, Wisconsin, have banned the sale of mercury fever thermometers.
- The sale of most mercury thermometers has been banned in Minnesota (some exemptions have been granted).

PCB Strategies and Related Actions

Various voluntary PCB reduction activities have already taken place or are underway in the Great Lakes region and the Lake Superior basin. Because of technical differences in the ways that PCB use and storage are reported in Canada and the United States, a binational inventory is not feasible at this

time. Reduction data will be reported separately in an update to the technical edition of the LaMP. Recent and current actions to identify, remove, and dispose of PCBs include the following:

- Revisions to Canadian federal PCB regulations and PCB storage regulations that phase out all PCB-containing equipment by 2008, allow storage for no longer than two years, and prohibit storage of all PCB-containing equipment by 2010.
- New Ontario draft regulations that require destruction of some 99,000 tonnes of PCBs (including contaminated soils) currently in storage in Ontario.
- Educational outreach to 30 facilities in the Canadian portion of the basin.
- A survey of U.S. facility decommissioning plans and a survey of voluntary commitment letters from Canadian PCB-containing equipment owners.
- Two workshops in Wisconsin and Minnesota in 2001 to train demolition and remodeling contractors to recognize PCB-containing equipment and become aware of disposal rules.
- A pilot project using state and federal funding to identify and dispose of PCBs at certain Minnesota facilities in the Lake Superior basin.

Pesticide Strategies and Related Actions

Various jurisdictions in the basin continue to carry out "clean sweep" collections of remaining stockpiles of banned pesticides from farmers and commercial appliers and to educate residents about their proper disposal. Household hazardous waste collections also continue in the basin. In the United States, tribal governments have conducted household hazardous waste collection and education activities within reservation boundaries as well as in surrounding communities.

Because of reporting differences between jurisdictions, compiling the quantity of pesticides collected in Michigan, Minnesota, and Wisconsin is difficult. Table 3-2 presents the amounts of pesticide estimated to have been removed from the U.S. portion of the basin.

In Ontario a two-year, province-wide collection program for obsolete pesticides in the agricultural and commercial sectors was initiated by the Crop Protection Institute in 2000 with assistance from provincial government agencies. In the first year of operation, the program collected 110,870 kilograms of outdated, unusable, or unregistered pesticides from 35 sites in southwestern Ontario. Continuing in eastern and northern Ontario in fall 2001, the program gathered 17,929 litres and 9,235 kilograms of pesticides from agricultural and commercial pesticide users. A licensed contractor was hired to

Table 3-2
Clean Sweep Collections of Pesticides in the Lake Superior States (U.S. Programs)

State	Dates of Collection	Substances Collected (pounds)					
		Aldrin/Dieldrin	Chlordane	DDT	Silvex	Toxaphene	Total Pesticide
Michigan[a*]	1995	147	25	193	Not estimated	0	365
Michigan[b]	2001	--	--	--	--	--	3,540
Minnesota[c*]	1992–1998	74	535	4,959	6,000	83	11,651
Wisconsin[d*]	1996-1998	0	36	97	28	480	641

[a] Compiled by Michigan Department of Agriculture (MDA). The Lake Superior counties collect about 9 percent of the pesticides collected in the state. The pesticides collected in these counties were calculated as 9 percent of the total for each pesticide collected.

[b] MDA estimates that the department removed 3,540 pounds of pesticides from the Lake Superior watershed in fiscal year 2001.

[c] Compiled by Minnesota Department of Agriculture Waste Pesticide Collection Program. Data include all Lake Superior counties' waste pesticide collections.

[d] Compiled by Wisconsin Department of Agriculture, Trade, and Consumer Protection for 1996. Compiled from collection event summaries of the Northwest Regional Planning Commission for 1997 and 1998.

* Data from Lake Superior LaMP 2000.

dispose of the pesticides at approved facilities in Quebec and Alberta.

Dioxin, HCB, and OCS Strategies and Related Actions

Because HCB and OCS can be formed along with dioxin during combustion, these three substances are dealt with as a single group. Projects conducted to identify and reduce sources of these substances range in scope from entire jurisdictions to individual reservations. Examples of dioxin, HCB, and OCS reduction actions include the following:

- Michigan, Minnesota, and Wisconsin have supported Hearth Products Association projects to provide incentives for individuals to switch to more efficient wood stoves. Natural Resources Canada has partnered with EcoSuperior to conduct a similar program in Thunder Bay.
- Ontario has drafted regulations that will phase out hospital incinerators and set new requirements for safe handling, transport, and treatment of biomedical waste.
- Various outreach efforts have been undertaken to discourage people from burning garbage in burn barrels, including a pair of Michigan brochures, a Superior and Douglas County brochure called "Slow Death by Fire," and a burn barrel campaign conducted by WLSSD featuring "Bernie the Burn Barrel."
- Ontario developed a survey based on one prepared by WLSSD to track burn barrel use in its portion of the Lake Superior basin.
- Wisconsin funded a project to develop a video for local officials on the problems associated with using burn barrels and various options for local garbage burning ordinances.
- The Grand Portage Tribe in Minnesota and the Red Cliff Tribe in Wisconsin are leading Native American efforts to eliminate the use of burn barrels.
- Wisconsin is continuing its site investigation at a wood preserving facility in Superior.

Open Burning of Garbage

Backyard burning of household trash endangers your health and the Lake Superior environment. Don't turn your trash into dioxin. Reduce your waste by making better purchasing choices and recycling. Use a garbage collection service or an approved landfill instead of burning trash. You can also reduce your purchases of toxic materials and take advantage of household hazardous waste collections to properly dispose of those materials that you no longer use.

Resource Materials:

The "Burning Household Waste" brochure developed by MDEQ lists pollutants emitted from burn barrels, some of the health consequences, and national household burn barrel emissions. It is available at the MDEQ Environmental Assistance Center, from district staff, or at *www.deq.state.mi.us/aqd/publish/95sblist.html*.

"Bernie the Burn Barrel" information, brochures, and posters that explain the problems associated with burn barrels and provide information on disposing of a burn barrel and its ashes at no charge are available from the WLSSD hotline at 218-722-0761.

The "Slow Death by Fire" brochure developed by the Lake Superior Toxic Reduction Committee is a pictorial storybook addressing the burn barrel issue. It is available at *thospond@ci.superior.wi.us*.

Burn barrel
Photograph courtesy of U.S. EPA

Efforts Across Jurisdictions

While the Lake Superior Binational Program continues to develop new projects specific to the Lake Superior basin, there are other initiatives that can have a significant impact on the basin. Examples

of efforts to integrate goals for Lake Superior include the following:

- Development in the United States of Lake Superior-specific standards for state water quality regulations.
- Coordination of chemical reduction schedules with Total Maximum Daily Loads in the United States.
- A partnership with the Great Lakes Binational Toxics Strategy to coordinate implementation activities for both programs

Continuing Challenges

Reaching the goal of zero discharge requires significant work by the residents and governments of the Lake Superior basin. Cooperative efforts among local, state, provincial, and federal governments will be required to achieve pollutant reductions that benefit the basin. Significant progress has been made in meeting the initial discharge targets, and this progress has been achieved through reduction of pollution from large sources of the critical pollutants. Meeting the next set of targets will be more difficult, as the sources are smaller and more dispersed and are not all controllable from the Lake Superior basin itself. This section outlines the remaining large-scale challenges facing the basin, challenges related specifically to control of PCBs and mercury, and challenges related to control of specific pollutant sources such as burn barrels and contaminated sediments.

Large-Scale Challenges

Meeting some challenges will require either national cooperation or very large amounts of money, and these challenges will be met only in the long term. Other challenges will require persistent effort to meet targets. Partnering with programs that address sources outside the Lake Superior basin (for example, the Great Lakes Binational Toxics Strategy) will serve to accelerate Lake Superior pollutant reductions. Some of these large-scale challenges include the following:

- Final retirement of mercury from the marketplace.
- Cleanup of 29 contaminated sites in harbors, in river mouths, and upland from Lake Superior as identified in LaMP 2000. Although these sites vary in their severity of contamination and size, remediation is usually an expensive and time-consuming undertaking (for example, at the Ashland Coal Tar site). Also, the

Contaminated Site Cleanup:
Ashland Coal Tar Site

The Ashland Coal Tar site includes a 10-acre area with high concentrations of PAH in bottom sediments and degraded aquatic habitat off Ashland's Kreher Park in Chequamegon Bay. The contamination originated from the on-land location of a former manufactured gas plant. Cleanup options are being considered by all the affected parties, including the public. In one on-land area of the Ashland city park, however, highly contaminated groundwater is "seeping" to the surface, posing a significant human health risk. In 2001, WDNR began remediation of the seep to reduce this risk. U.S. EPA recently designated the Ashland Coal Tar site as a Superfund site. The total price tag for site cleanup will likely exceed $100 million.

Cleanup of the "seep" area at the Ashland Coal Tar site.
Photograph by Jim Bishop,
Wisconsin Department of Natural Resources

endpoints chosen for cleanup efforts are not always compatible with LaMP goals.

- Tracking of compliance with federal, state, and provincial regulations governing incineration of wastes and dioxin releases.

PCB Challenges

An essential first step in the virtual elimination of PCBs in the basin is completing the inventories of in-use and destroyed PCBs. Moreover, an expanded outreach effort for PCB disposal is necessary. Canadian owners of PCB-containing equipment responded to outreach efforts in the 1990s, but challenges remain to monitor and promote targeted decommissioning of PCBs in use and PCB destruction. Passage of new national legislation requiring phase-out of PCB use and prohibiting PCB storage together with new Ontario regulations for destruction of PCBs in storage would greatly increase the likelihood of meeting the 2010 target of 90 percent destruction.

In the United States, U.S. EPA and Minnesota are funding a pilot project to identify and dispose of PCBs used in smaller facilities such as municipal utilities and electrical cooperatives. If this pilot project is successful, additional projects in other parts of the basin might be funded.

Thunder Bay AOC
Sediment Remediation Partnership

Abitibi Consolidated Inc., Northern Wood Preservers Inc., Canadian National Railway Co., Environment Canada, and the Ontario Ministry of the Environment have been working in a unique partnership to isolate sources of contamination, clean up contaminated sediments, and enhance fish habitat at the Northern Wood Preservers pier in Thunder Bay Harbour. Commencing in 1997, remediation activities included construction of a rockfill containment berm, dredging, treatment of contaminated sediments, and isolation of the pier with low-permeability barriers and groundwater control facilities. Restoration of fish habitat and wetlands has progressed, bringing the project near to completion by the end of 2001. Monitoring programs will ensure that groundwater and sediment conditions and aquatic habitat continue to improve around the pier. Completion of this project will mark a milestone as we bring Thunder Bay Harbour closer to delisting as an AOC.

Mercury Challenges

Between 1990 and 2000, the Lake Superior basin exhibited decreases in mercury use and releases that met the Binational Program's 60 percent reduction target. However, mercury releases in the Lake Superior basin continue at a rate of over 800 kilograms per year. Most of the mercury enters Lake Superior and its watershed through air emissions, with the two largest sources being the utility (energy production) and mining sectors. Atmospheric release of mercury has been an unregulated emission, meaning that when air permits are issued, no limits are placed on mercury releases. To meet the reduction targets for the next decade, mercury emissions from coal and ore processing and use of mercury in products and processes would need to be significantly reduced.

A global challenge for the future is to develop national strategies that "retire" mercury by completely removing it from the marketplace. The current practice of taking old mercury-containing products to recyclers who sell the recovered mercury to manufacturers that use it in their products does not result in a net reduction in mercury use. Mercury in certain forms is extremely toxic, and collection and recycling do not reduce the risk of its entering the food chain.

Dioxin - a Burning Issue

In 1990, many thousands of small, inefficient incinerators were a major source of dioxin emissions in the basin. Air emission controls required by basin governments in the 1990s have largely controlled this dioxin source, although the governments need to confirm that the incinerator sector is in compliance. Hospital incineration remains a significant source of dioxin in the atmosphere. Use of burn barrels for backyard garbage burning is a continuing challenge in the rural portion of the Lake Superior basin. This practice produces dioxin that can be deposited on crops, posing human health risks through food consumption.

Peninsula Harbour, Ontario, AOC

The Town of Marathon, with support from Environment Canada, and the Ontario Ministry of the Environment, FedNor, and the Ontario Great Lakes Renewal Foundation, has commenced a feasibility study for removal and disposal of mercury- contaminated sediments in conjunction with development of marina facilities in Peninsula Harbour. To maximize land use in the harbour, some of the land-based portion of the marina may be situated over the containment and disposal facility. The feasibility study, which began in 2000, includes compilation of existing data, investigation of current contaminated sediment conditions, and investigation of potential locations for the facility and marina. A risk assessment of dredging and disposal options and detailed conceptual designs for the facility and marina will be completed by the end of 2002. These activities will provide direction and focus for the remedial work as Peninsula Harbour moves toward delisting as an AOC.

Contaminated Bottom Sediments

Although Lake Superior is the cleanest of the Great Lakes and the other Great Lakes have more contaminated sites, Lake Superior's history of heavy industry in its harbor communities has left a legacy of contaminated bottom sediments. Some of these areas have been designated as AOCs. Sites with polluted bottom sediments can serve as source areas for contaminants that bioaccumulate in Lake Superior fish and wildlife. These harbors and bays should be restored to productive shallow-water habitat that serves as the biological engine for the Lake Superior ecosystem. Considerable funding is required to investigate these sites, determine their degree of contamination, remediate them, and finally restore them to important aquatic habitat.

Recent activities at the Deer Lake, Michigan, AOC include sediment sampling and a U.S. EPA GLNPO-funded feasibility study to determine cleanup options for the site. The sediment sampling was performed by MDEQ, Michigan State University, and U.S. EPA. The feasibility study, which is nearing completion, examines various cleanup options for the AOC, including fish and dam removal, dry and wet dredging, in situ gel and sand capping, and natural attenuation.

There is still a need to investigate and remediate other sites that may contain chemicals of concern. Funding for these activities has thus far been limited, but projects include the following:

- Characterization and a search for funding sources for cleanups at the Newton Creek/Hog Island inlet site in Superior and the Ashland Coal Tar site in Wisconsin.
- Site investigation at a wood preserving facility in Superior, Wisconsin.
- Public meetings on remediation options for Stryker Bay in Duluth, Minnesota.
- Remediation of contaminated sediments at a wood preserving facility in Thunder Bay Harbour (Ontario) is nearing completion and investigation of other issues within the harbour continues.
- U.S. EPA Superfund Division's removal program will be undertaken with WDNR beginning in the spring of 2002. Superfund will provide On-Scene Coordinator (OSC) personnel to work with WDNR to complete a "sweep" of the Superior area to identify hazardous waste sites for potential time-critical removals.

What You Can Do

National programs and programs that target individual economic sectors will make great strides toward meeting the zero discharge goal, but zero discharge can only be achieved if the residents of the Lake Superior basin make informed choices. Community-based programs are key to promoting such decision-making.

People often feel that reducing pollution, protecting habitat, and building sustainable local economies are beyond their control. In reality, everyday choices made by consumers, investors, and community volunteers can make a great difference for Lake Superior. Listed below are some of the things that you can do on a day-to-day basis to protect Lake Superior from toxic chemicals.

What Can You Do to Reduce the Nasty Nine?

Conserve energy and water

If you use less energy and conserve water, you'll be saving more than money because conservation reduces releases of pollutants overall, and specifically reduces mercury emissions from coal-fired electricity production.

Purchase "green" electricity

Explore the option of purchasing "green" electricity from wind or solar power suppliers in your community.

Be mercury-wise

Buy products such as thermometers, thermostats, appliances, medicine, and fishing and hunting equipment that are mercury-free. If you find it hard to believe that sporting goods could contain mercury, be aware that some fishing tip-ups, dog training collars, and hunting bows contain this chemical. When buying medicine and pharmaceuticals, avoid products containing the compounds phenyl mercuric acetate (PMA) and thimerosal, which might be listed as preservatives. When you are ready to dispose of mercury-bearing products, recycle them rather than throwing them in the trash or down the drain.

Use less plastic

Reduce use of plastic, especially polyvinyl chloride (PVC), which may release dioxin during manufacturing and later if it is burned. Recycle plastic products when they are no longer useful.

Know what to do if you find hazardous materials in your home

If you find mercury or other hazardous materials in your home, contact your local household hazardous waste program.

Know what to do with mercury spills

Know what to do if you spill mercury in your home or workplace. This is especially important in places where children are present. Don't let children play with mercury. Check out the following web sites for mercury cleanup advice:

http://www.uwm.edu/Dept/EHSRM/LAB/PPT/sld001.htm

http://www.mpshu.on.ca/EnvironmentalHealth/mercury%20CLEANUP.htm

Know the alternatives to mercury amalgam fillings

Talk with your dentist about mercury and silver amalgam fillings. Discuss the alternatives, and ask what the dentist is doing to limit and dispose of mercury waste.

Dispose of trash properly

Dispose of your trash properly. Burning or dumping garbage creates environmental problems.
See the discussion of open burning in this report for more information.

Dispose of fluorescent lamp ballasts properly

If you have a fluorescent lamp made before 1981), don't dispose of it without checking whether it has a PCB-containing ballast that should be removed. If the ballast is not labeled "No PCBs," consider it hazardous waste and contact your local household hazardous waste program. In addition, the lamp itself may contain mercury and should be recycled or disposed of during a hazardous waste collection.

Remove mercury and PCBs from old appliances and cars

When disposing of large household appliances and cars, ask the trash service, recycler, or salvage yard whether mercury switches will be removed. Old refrigerators can also have PCB-containing ballasts, so if you are disposing of an old refrigerator, ask about that too.

Switch to more efficient woodstoves

By switching to more efficient woodstoves, you can reduce releases of toxic substances to the atmosphere. One example of the efforts to support such switches is the Hearth Products Association's woodstove exchange program. For more information, see *http://www.woodstovechangeout.org*

Find out what devices contain mercury

You can get a list of mercury-containing devices from a new educational software tool on mercury in buildings designed for use by the construction and demolition industry at:

http://danpatch.ecn.purdue.edu/~mercury/scr/frame.htm

3.2 Air Transport and Deposition of Pollutants: Local and Long-Range Sources

The atmosphere is the major pathway through which the nine critical pollutants enter the lake. The large surface area of the lake collects materials and toxic contaminants from rain and snow and directly from the air. Air emissions of critical pollutants from sources such as incinerators, power plants, mining operations, and burn barrels within the basin can be deposited directly to the lake or can enter the lake via its tributaries in watershed runoff. Air emission sources in the Lake Superior basin are included in the scope of the ZDDP. Strategies and actions for addressing these sources are discussed in Section 3.1. Provided below is an overview of the deposition of critical pollutants that highlights actions being taken by Lake Superior basin jurisdictions to control air emissions.

Critical pollutants from distant sources also travel through the atmosphere to be deposited in Lake Superior. For example, organic chemicals and metals such as mercury readily travel long distances in their vapour states. Figure 3-1 summarizes the many pathways taken by pollutants in the atmosphere. Computer modeling suggests that 85 percent of the dioxin deposited in Lake Superior originates from sources over 400 kilometers away. Incineration, metal processing, and fuel combustion are the main sectors that comprise the thousands of dioxin sources for Lake Superior. In 1996, the largest 100 of these sources were estimated to contribute over two-thirds of the dioxin deposited to Lake Superior. Although they have not yet been proposed, U.S. Maximum Achievable Control Technologies (MACT) standards that will apply to municipal and medical incinerators are expected to significantly reduce the relative contribution of this sector.

Atmospheric Deposition of Toxic Chemicals to Lake Superior

The binational Integrated Atmospheric Deposition Network (IADN) measures the magnitude and trends of atmospheric loadings of toxic contaminants to the Great Lakes. These measurements integrate loadings from local in-basin sources, continental out-of-basin sources, and even global sources. Since 1990, IADN has maintained Lake Superior monitoring stations at Eagle Harbor, Michigan; Brule River, Wisconsin; Sibley, Ontario; and Turkey Lakes, Ontario. At these stations, concentrations of toxic chemicals are measured in both the air and precipitation phases.

IADN reports decreasing atmospheric deposition of the pesticide hexachlorocyclohexane (HCH) throughout the Great Lakes Basin. This decrease is partly a result of decreases in global use of HCH. Trends in atmospheric concentrations and loadings of HCH reflect changes in its production and use, as shown in Figure 3-2. Annual global use of technical HCH from 1980 to 1995 (Li 1999)

Figure 3-1 Pathways of transport and accumulation of continental pollutants

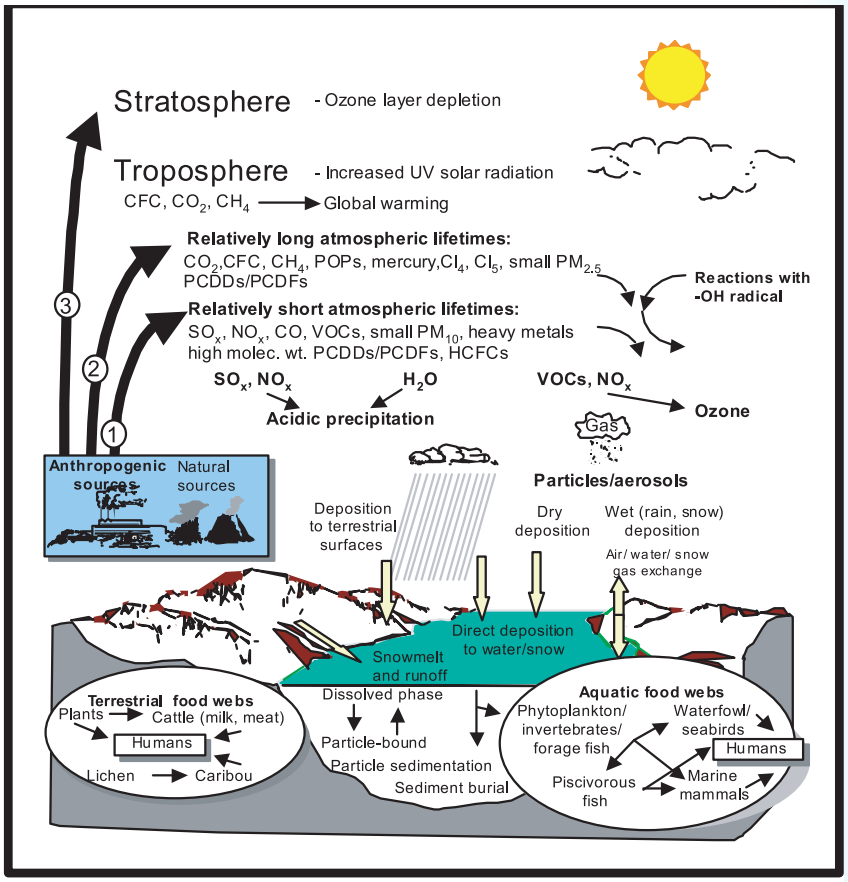


Figure credit: North American Commission for Environmental Cooperation

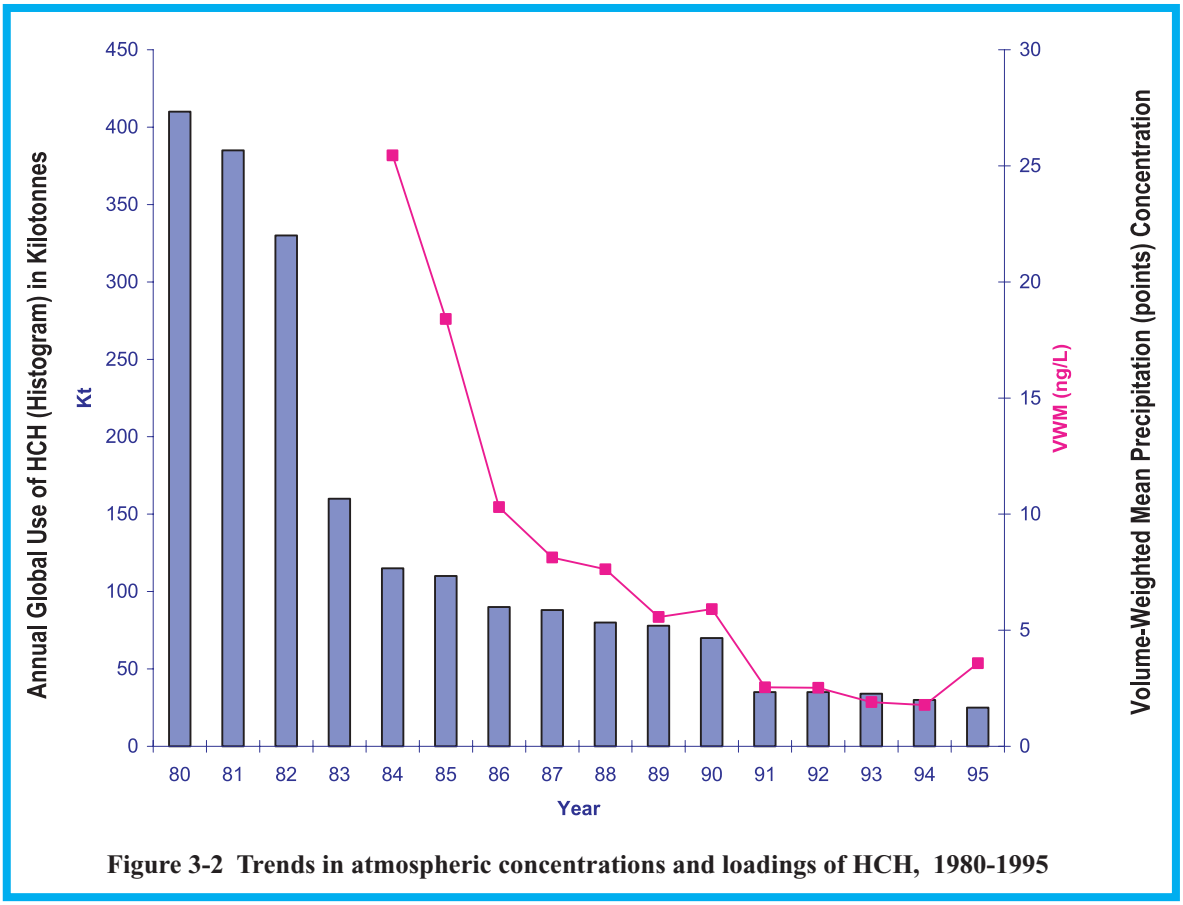


Figure 3-2 Trends in atmospheric concentrations and loadings of HCH, 1980-1995

and the resulting trend in volume-weighted mean precipitation concentrations of a-HCH as measured at Sibley are shown in the figure (Chan, unpublished data). Three main declines in the global use of HCH have occurred. The first began in the 1970s when countries such as Canada, Japan, and the United States restricted use of HCH. A second decline occurred in 1983 when China banned its use. The third decrease began in 1990 when the former Soviet Union completely banned its use and India banned its use for agricultural purposes. These governmental actions to protect our air, water, and food have resulted in significant decreases in the concentration of HCH in the environment as demonstrated by measurements made in the air (Figure 3-2).

Although HCH is not a critical pollutant for Lake Superior, its patterns of manufacture, use, and transport are similar to those of pesticides found in Lake Superior; therefore, the behavior of HCH can serve as a surrogate for their behavior.

As shown in Figure 3-3, trends in wet deposition inputs (from snow and rain) of organochlorine pesticides to Lake Superior have declined since 1992, much like trends observed across the basin, while PCB inputs appear to be remaining constant. The lower Great Lakes showed increasing wet deposition inputs of selected polynuclear aromatic hydrocarbons (PAH); in contrast, the PAH wet deposition trend for Lake Superior appeared to remain stable from 1992 to 1998.

IADN estimates wet, dry, and gas deposition to the Great Lakes and, based on air-water exchange information, is able to determine amounts of pollutants that are volatilizing from the lakes. IADN's results indicate that the concentrations of pollutants deposited in Lake Superior from the air are generally decreasing. However, for some chemicals, the atmosphere is a source of pollutants for the lake (by deposition), and the lake is becoming a source for the atmosphere-that is, the amount of a chemical volatilizing or degassing from the lake exceeds the amount that is being deposited in the lake through precipitation or direct absorption. When the net loading of a given chemical is out of the lake, this contributes to decreasing in-lake concentrations.

The most recent (1998) IADN loading estimates indicate that volatilization of a-HCH, dieldrin, cis- and trans-chlordane, and PCBs from Lake Superior is far greater than the total deposition to the lake; that is, the lake is a source of these pollutants for the atmosphere. In contrast, the atmosphere is still increasing the in-lake concentrations of DDT, lindane, a-endosulfan, HCB, and several PAHs.

Pesticide Clean Sweeps

U.S. EPA Region 5 has compiled data from agricultural clean sweeps conducted between 1988 and 2000 by Great Lakes states (excluding New York). An estimated 1.9 million pounds (900,000 kilograms) of pesticides was collected from stockpiles held by farmers and commercial appliers in the Great Lakes basin. Figure 3-4 summarizes the amounts collected in the six states. Although some of the pesticides removed are measured by IADN, it is not currently possible to link the pesticide data sets.

What is Being Done About Air Deposition of Pollutants

Many activities have been undertaken by national, state, provincial, and Tribal/First Nations governments to protect the Lake Superior basin from air pollution sources. This section addresses mercury reduction activities by jurisdiction. For a more comprehensive summary of activities in each jurisdiction, please visit the web sites cited in the text. The section ends with an overview of international initiatives.

Federal Governments

Atmospheric deposition of mercury from nearby and distant sources is the major pathway for this chemical into Lake Superior and its watershed. The two largest sources of mercury emissions to air in the Lake Superior basin are energy production and ore processing. Atmospheric releases of mercury from

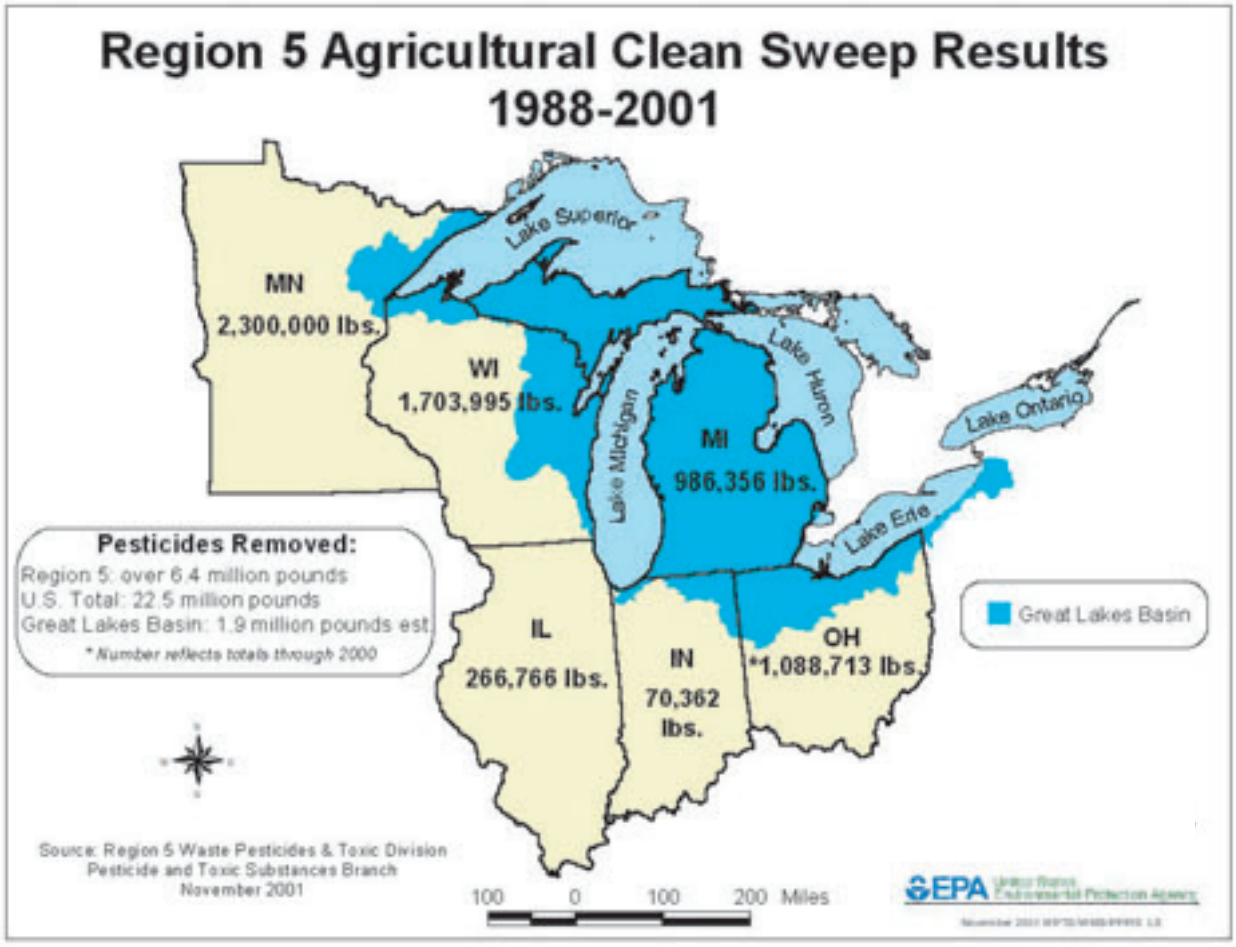


Figure 3-4 Pesticide clean sweeps in U.S. EPA Region 5 states

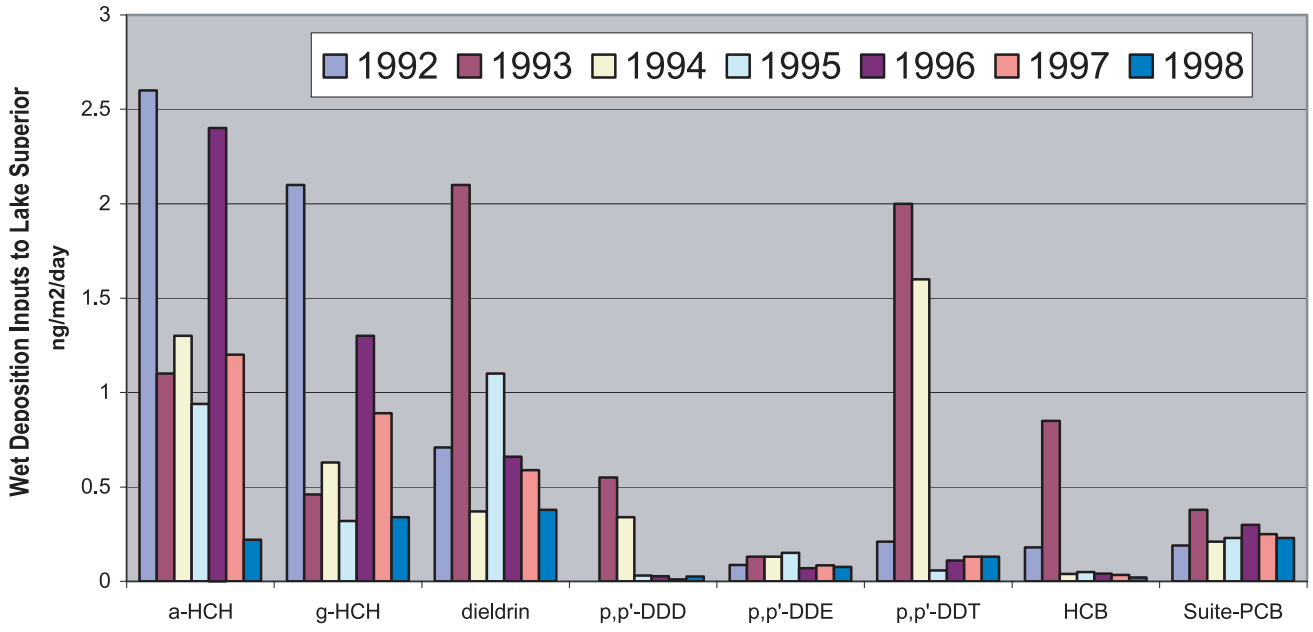


Figure 3-3 Trends in Lake Superior wet deposition inputs 1992-1998

coal combustion and the mining sector have been unregulated emissions.

Recently, U.S. EPA made a determination to regulate specific mercury emissions to air. Mercury is already a regulated chemical in some circumstances. Federal government actions to regulate mercury include the following:

- Mercury Emissions from Electric Utilities: In December of 2000, U.S. EPA announced that it is appropriate and necessary to regulate mercury emissions from electric utility plants. U.S. EPA is scheduled to propose the regulation by December 15, 2003, and promulgate a final regulation by December 15, 2004. The President proposed another approach in February 2002 -- development of a nationwide cap and trade program that would reduce electric utility mercury emissions 69 percent from current levels. Congress is considering this initiative.

- Regulate Mercury Emissions from Other Electric Producers: Industrial, commercial, and institutional boilers, found in businesses and industrial plants throughout the United States, may use coal, oil, or natural gas as fuels. As with utility boilers, emissions of mercury occur when mercury present as a trace contaminant in the fuels is volatilized and released in the gas exhaust stream. Mercury emissions from this source category were estimated to be approximately 3 tons per year in the 1993 NTI. U.S. EPA plans to propose a rule to limit emissions of hazardous air pollutants from industrial, commercial, and institutional boilers under Section 112 of the CAA. A proposal is scheduled for the summer of 2002.

- Mercury Phase-out Proposal: In lieu of TMDLs for water bodies in U.S. EPA Region 5, including the Great Lakes, U.S. EPA is proposing a mercury phase-out. The proposal would allow Region 5 states to forego development of TMDLs for all mercury-impaired waters if they commit to specific conditions such as expediting air and National Pollutant Discharge Elimination System (NPDES) permitting for mercury sources.

Other specific incinerator sources of mercury emissions to air in the United States have been regulated. U.S. EPA has already addressed three of the major mercury emission source categories (medical waste incinerators [MWI], municipal waste combustors [MWC], and hazardous waste combustors [HWC]) through promulgation of emission control regulations. Based on 1990 mercury emission levels, these MACT regulations are expected to reduce mercury emissions from

MWIs and MWCs by approximately 90 percent and from HWCs by approximately 60 percent.

By 2004, the U.S. federal government will be setting mercury air emission limits by 2004 for the energy (utility) sector and the states will then apply these limits to their permitted facilities.

In Canada, the federal and provincial ministers of the environment have developed Canada-Wide Standards (CWS) for sectors releasing mercury to the environment. The standards are voluntary, but provinces may choose a regulatory framework to implement them.

- In 2000, a CWS for waste incineration was endorsed that would apply numerical targets to exhaust gases from existing, new, or expanded municipal, hospital, hazardous waste, and sewage sludge facilities. The timeframe for achievement is 2003 to 2006.
- In 2001, a CWS was endorsed for an industry-led initiative to reduce the mercury content of mercury-containing lamps (mainly fluorescent tubes).
- In 2001, a CWS was signed that requires use of best management practices for dental amalgam. The national goal is a 95 percent reduction in mercury releases associated with dental waste discharges by 2005.
- In 2002, ministers are expected to formally consider a standard for electrical power generators.
- CWSs for air are under development for base metal smelting, incineration, the iron and steel industries, and fuel combustion.

State, Provincial, and Tribal/First Nations Governments

States, Tribes/First Nations, and the Province of Ontario have been implementing air emission control programs for over 25 years. The following case study from Michigan is illustrative of a jurisdiction's actions over time.

Michigan's Air Program: A Case Study

Michigan's environmental and health departments have been very concerned about releases of mercury for decades. Some of their activities include the following: requiring best available control technology for new and modified permits for all toxic pollutants, including mercury; adopting strict federal controls for all municipal waste incinerators; and adopting standards that are even stricter than the federal controls for mercury emitted from MWIs. Michigan has also supported development of federal regulations for coal-burning utilities.

In 1996, the Michigan Mercury Pollution Prevention (M2P2) Task Force released a report that listed high-priority mercury reduction activities to be implemented by a variety of stakeholders. Such stakeholders included healthcare facilities, dentists, automobile manufacturers, schools, dairy farmers, and laboratories. For a summary of the reduction activities, visit MDEQ's web site at *http://www.deq.state.mi.us/ead/p2sect/mercury/*.

Other specific mercury reduction activities in Michigan include the following:

- Developed an air toxics emissions inventory for air toxic pollutants *(see http://www.glc.org/air/rapids/rapids.html)*.
- MDEQ and Wisconsin, using settlement funds, awarded the University of Michigan a grant to conduct research in the Lake Superior basin in order to better understand atmospheric deposition.
- MDEQ, working with the University of Michigan, received a grant from the Michigan Great Lakes Protection Fund to establish a mercury monitoring network in the state.
- MDEQ adopted one of the strictest standards in the nation for controlling mercury emissions from hospital, medical, and infectious waste incinerators. Michigan regulations also require hospital incinerator operators to submit a waste management plan that demonstrates that the generator of medical waste has eliminated known mercury-containing materials.
- MDEQ worked with the Multimedia Pollution Prevention Task Force to eliminate bulk mercury from dental offices, worked with automobile

manufacturers to phase out the use of mercury in automobiles and sent letters to Michigan hospitals asking them to phase out mercury use. Numerous education and outreach materials have also been developed to promote mercury reduction.

Ontario Emission Monitoring

The first phase of Ontario's emission monitoring and public reporting initiative began on May 1, 2000. In this phase, the electricity sector was required to monitor and report on 28 pollutants, including mercury (Hg) and the key contributors to climate change, smog, and acid rain: carbon dioxide (CO2), nitrogen oxides (NOx), and sulphur dioxide (SO2).

The next phase, which began on May 2, 2001, covers 358 pollutants. Additional key contributors to climate change and smog, such as nitrous oxide, methane, carbon monoxide, particulate matter (PM 2.5), and volatile organic compounds, were included in the new regulation. The regulation also includes pollutants addressed in the National Pollutants Release Inventory (NPRI).

Beginning on January 1, 2002, other industrial, institutional, commercial, and municipal emitters will be required to monitor and report on their seasonal and annual emissions of the 358 regulated pollutants. This new monitoring and reporting program is a vital step toward improving air quality, addressing long-range transport of critical pollutants, motivating companies to lower their emissions, leveling the environmental playing field for companies in all economic sectors, setting and enforcing new emission limits, and laying the groundwork for innovative new initiatives like Ontario's proposed emission reduction trading system. Moreover, the new monitoring information will provide valuable, comprehensive data that can be used to determine actual air transport loadings of mercury and dioxin to the Lake Superior basin from all the commercial and industrial sources in Ontario.

Minnesota Voluntary Mercury Reduction Initiative

Minnesota is experimenting with a voluntary mercury emission reduction approach through the Voluntary Mercury Reduction Initiative. Under a Minnesota statute, all facilities that emit more than 50 pounds of mercury per year have been asked to participate in a voluntary reduction program. To date, MPCA has received 15 voluntary agreements to reduce mercury emissions. Some of the agreements were even submitted by companies that release less than 50 pounds of mercury per year.

The law required that MPCA report on progress made on mercury emission reductions in October 2001 and again in 2005. The 2001 report can be found at http://www.erc.state.mn.us/. The Minnesota statewide inventory shows that significant emission reductions have already occurred as a result of the decrease in use of mercury in products. In one case, a taconite mineral processing facility removed over 400 kilograms of mercury through use of process controls and replacement of mercury-bearing equipment. Future emission reductions will depend on progress in economic sectors where mercury is incidentally released during such processes as fuel combustion and ore processing.

The Minnesota initiative program has a special Lake Superior connection. The statewide mercury reduction goal of 60 percent by 2000 is the same as that for Lake Superior, and the statewide goal of 70 percent reduction by 2005 is bracketed by the Lake Superior reduction milestones of 60 percent by 2000 and 80 percent by 2010.

Wisconsin's Proposed Rule to Reduce Mercury Emissions

Wisconsin is working on a mercury emission regulatory program targeting coal-burning power plants and other large mercury sources. Believed to be the largest source of mercury pollution in the state, coal-fired power plants have been identified as crucial in addressing the problem of mercury in the environment. In 2001, Wisconsin issued a statewide fish consumption advisory because of mercury contamination. Regulatory actions that Wisconsin and some other states are taking may influence and inform federal mercury reduction policy and actions.

In December 2000, the Wisconsin Natural Resources Board adopted a resolution that granted a citizen petition seeking rule-making to reduce mercury emissions to the air. At the direction of the board,

WDNR developed a proposed rule that would reduce mercury emissions but would not interfere with the ability of electric utilities to supply the state's energy needs. The proposed rule calls for a phased reduction of 30, 50, and 90 percent in the mercury emissions from coal?burning power plants in Wisconsin over 15 years. The rule would set mercury emission ceilings for large sources and would require new sources to offset increases in mercury emissions. The rule would allow sources to earn emission reduction credits based on voluntary activities such as pollution control equipment installation, process changes, and pollution prevention. The emission reduction credits would allow a major utility to achieve up to 50 percent of its emission reduction requirement. The proposed rule also provides for ongoing evaluation of the feasibility of mercury reduction, federal regulatory development, and review of long?term mercury storage and disposal issues.

Public review of the proposed rule provisions and alternatives is scheduled to conclude in October 2001. The current proposal states that within two years of rule promulgation, major utilities and large stationary sources must provide baseline mercury emission information *(see www.dnr.state.wi.us/org/caer/ce/mercury/)*.

Tribal/First Nations Governments of Lake Superior (U.S. Focus)

Tribal/First Nations governmental agencies within the Lake Superior Basin have programs or have undertaken projects that monitor physical and chemical contamination in the air. The Fond du Lac Band of Lake Superior Chippewa (FDL) and the Bad River Band of Lake Superior Chippewa have ongoing air monitoring programs that measure mercury deposition and particulate matter as well as other elements. In addition to mercury, FDL monitors weekly for acid, quarterly for dioxin, seasonally for ozone, and continuously for fine particulates (PM2.5) and will soon add continuous monitoring for NOx. The Inter Tribal Council of Michigan Inc. is collaborating with Environment Canada, Ontario Ministry of the Environment, U.S. EPA, and the Michigan Department of Environmental Quality to conduct joint U.S.-Canadian air monitoring in the Sault Ste. Marie area. The purpose of the monitoring is to characterize the amounts of fine and course particulate matter in the air. Keweenaw Bay Indian Community (KBIC) completed a study to characterize overall ambient air quality on the L'Anse Reservation. Between February 2000 and February 2002, KBIC monitored the levels of particulate matter in the air as well as analyzing those samples for mercury and other trace heavy metals. KBIC's preliminary results verify that PM2.5 levels are indeed low in the vicinity of the Reservation. U.S. EPA provided support for many of these projects and programs.

The Tribal governments listed above as well as Tribal governments like the Grand Portage Band of Lake Superior Chippewa and the Red Cliff Band of Lake Superior Chippewa are at various stages of investigating or pursuing either air monitoring programs or federal authorization through Treatment as a State to regulate air quality on reservations. Some Tribes, like the Red Cliff Band, are interested in increasing their air quality designation to a more stringent level (Class I), which would give them protections similar to National Parks.

International Initiatives

Recognition of the threat of air deposition of pollutants led to the signing of the Global Treaty on Persistent Organic Pollutants (POPs) in May 2001 by 122 countries, including the United States and Canada. The treaty requires countries to reduce or eliminate production, use, or release of 12 POPs. An international treaty was required because POPs linked to adverse health effects can travel thousands of miles through the atmosphere. Domestic implementation of the treaty's provisions is required of the signatories, and regional implementation is encouraged. For more information on the POPs Treaty, including an informational brochure, please see *www.epa.gov/oia*.

The current list of POPs includes

- Pesticides: aldrin, dieldrin, endrin, DDT, mirex, chlordane, heptachlor, HCB, and toxaphene
- Industrial chemicals: PCBs and HCB
- Unintentional by-product pollutants: dioxins and furans as well as PCBs and HCB

Except for mirex, all the POPs are on the list of critical pollutants for Lake Superior. The complete list of critical pollutants, which includes heptachlor and endrin, for example, can be viewed at *http://www.epa.gov/glnpo/lakesuperior/chapter1.html.*

In the United States and Canada, there is no production, import, or export of any of the POPs pesticides. However, the United States expects HCB to be produced and used as a closed-system, site-limited intermediate consistent with the provisions of the POPs Treaty. Both governments have banned manufacture of PCBs, and the United States has imposed stringent controls on releases of dioxins and furans to the atmosphere.

The 1994 North American Agreement on Environmental Cooperation among Canada, Mexico, and the United States provides the framework for cooperation regarding environmental issues. North American Regional Action Plans (NARAP) have been developed and approved for DDT, chlordane, PCBs, and mercury. NARAPs for cluster dioxins, furans, and HCB and for environmental monitoring are also under development. Lindane and lead are candidates for future NARAPs.

Specific actions associated with the NARAPs include a North American air emission inventory for mercury sources and releases and a proposed mercury air monitoring network for Mexico. Alternative PCB disposal technologies were analyzed in 2001. Mexico has implemented the DDT NARAP two years ahead of schedule. With the cessation of chlordane manufacture, the associated NARAP was successfully concluded. In 2001, a baseline air emission inventory was prepared for dioxins and furans; this inventory will be linked with existing national inventories. Collaborative work will soon commence to set up a dioxin and furan monitoring network in Mexico.

Photograph by Patrick T. Collins, Minnesota Department of Natural Resources

Ecosystem Progress Report

Accomplishments:

1. Restoring coaster brook trout habitat on the Salmon-Trout River
2. Implementing a water management plan for hydroelectric facilities on the Nipigon River
3. Implementing mark-and-recapture studies to estimate the number of sea lampreys entering Lake Superior
4. Implementing spring lake trout surveys throughout Ontario by the Ontario Ministry of the Environment
5. Acquired funds through U.S. Geological Survey and Great Lakes Environmental Research Laboratory to begin acoustic surveys on Lake Superior
6. Applied the ECOSIM and ECOSPACE whole fish community models to Lake Superior
7. Implementing Sugarland Cove and Michigan Upper Peninsula wetland restoration projects
8. Began the planning process for Lake Nipigon Basin Signature Site
9. Completed a biological diversity inventory and developing a management plan for the Lake Superior highlands
10 Implementing the peregrine falcon recovery program in Ontario; documented all peregrine activity in the province

Challenges:

1. Determining the "healthy" mammalian community structure in the basin
2. Continuing neotropical migrant bird population monitoring
3. Placing greater emphasis on amphibian and reptile restoration and protection
4. Managing shoreline development
5. Promoting local land use management laws and projects to protect wetlands

Next Steps:

1. Conduct greater outreach to local communities and provide resources to support habitat restoration and protection projects
2. Continue developing a comprehensive set of ecosystem targets
3. Continue working on balancing effective control measures for exotic species with preservation and restoration of native species
4. Implement the "Great Lakes Action Plan for the Prevention and Control of Nonindigenous Aquatic Nuisance Species"

Section 4:

The Lake Superior Ecosystem - Status and Challenges

Aguasabon River, Ontario
Photograph by Patrick T. Collins,
Minnesota Department of Natural Resources

Introduction

Lake Superior and its watershed comprise one of the most complex ecosystems in North America. An ecosystem consists of the interactions between biotic (animals, plants, and microorganisms) and abiotic (rocks, soil, air, and water) elements in the environment. These interactions define the function of the plants and animals that live in a particular ecosystem. Stresses on the ecosystem, such as land uses that disturb the soil and result in increased siltation in streams and lakes, have differing effects on the plants and animals that live there.

LaMP 2000 examined stressors and their impacts on individual components of the Lake Superior ecosystem. This section discusses these stressors; provides an update on the status of the Lake Superior ecosystem, and describes some of the protection and restoration work done by local communities in cooperation with state, provincial, tribal, and federal agencies; and offers strategies for addressing future challenges.

Stressors on the Ecosystem

The list of plant, animal, and habitat stressors identified in LaMP 2000 is long and diverse. Most stressors are directly associated with human activities (a short list is provided in Table 4-1). For example, species such as wild rice, caribou, and loons can be negatively affected by human activities. Habitat functioning can be reduced or eliminated by human activities such as construction of barriers on tributaries or fire suppression in valuable terrestrial habitat. Habitat structure is simplified by human activities such as separating large forests into smaller parcels during development and stabilizing water levels to eliminate flood events. In addition, people affect biological communities, such as fish populations or native plants, by introducing invasive, exotic species into forests, wetlands, lakes, and streams.

One of the difficulties with having such a diversity of stressors is that there is no short list of indicators that could be used to monitor the health of the Lake Superior ecosystem. To this end, a set of five biological, community-based indicators has been explored and is now being developed to assess the "health" of the terrestrial system: (1) breeding migratory birds, (2) medium-sized carnivores, (3) reptiles and amphibians, (4) soil invertebrates and mosses, and (5) lichens and fungi (see Table 4-1). Additional indicators are being developed for the